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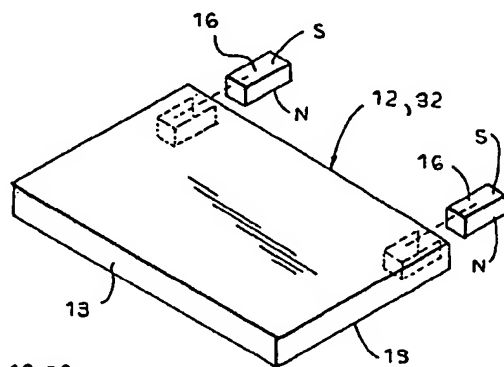
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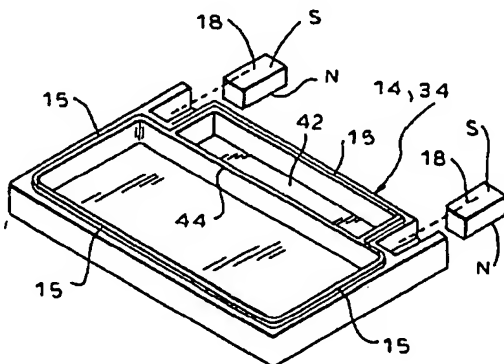
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[Continued on next page]

(54) Title: **VIRTUAL HINGE**



(57) Abstract: A magnetic or virtual hinge (10) defining a virtual hinge axis (20) includes first (12) and second (14) plates of non-magnetic material, and first (16) and second (18) magnets disposed in the respective plates adjacent the hinge axis for movement therewith. The first and second members are movable about the hinge axis between closed and open orientations.



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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## VIRTUAL HINGE

## CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of Provisional Application No.

5 60/285, 886 filed April 23, 2001.

## BACKGROUND OF THE INVENTION

The present invention relates to a virtual hinge, and more particularly to a magnetic hinge having a virtual hinge axis.

A conventional physical hinge consists of a pair of hinge plates  
10 pivotably secured together by a hinge pin enabling movement of the hinge plates between first and second orientations relative to one another. For ease of reference, the first and second orientations are commonly referred to as "closed" and "open" orientations. In the closed orientation the first and second plates are generally parallel and at least partially overlapping, while in the open  
15 orientation the first and second plates are generally parallel and at least partially non-overlapping or (that is, the plates have been moved 180° relative to one another) or the plates are non-parallel (whether at right angles or non-right angles) relative to one another. While the conventional physical hinges typically perform well in a variety of different environments, they have not  
20 proven to be entirely satisfactory in particular environments for one or more of the following reasons:

1. The conventional physical hinge is either internally or externally hinged. When two structural components are externally hinged, the overall dimensions of the structural components (e.g., the hinge plates) must be  
25 increased to incorporate the physical hinge pin and also so that at least one edge of each structural component is at least partially wrapped around the common hinge pin; this is disadvantageous as it increases the size of the structure formed by the structural components. Where the hinge is internal (that is, disposed between the structural components when the hinge is in the  
30 closed orientation), some of the space between the structural components in the

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closed orientation must be sacrificed to allow for the volume occupied by the physical hinge pin. In other words, the conventional physical hinge either limits the compactness of the structure employing it or requires the a portion of the otherwise useable space within a structure be dedicated to the hinge pin.

5                   2.     The conventional physical hinge is not readily deconstructed – that is, in order to separate the hinge plates from one another, typically either the hinge pin must first be removed from the hinge or the edge portion of at least one of the hinge plates which at least partially wraps around the hinge pin must be stretched, broken or the like to enable its separation from  
10 the hinge pin. This is frequently an arduous and difficult operation, often as arduous and difficult as the reconstruction or reconstitution of the hinge subsequently when the same is desired. Thus the conventional physical hinge has hinge plates which are neither readily manually separable from one another nor readily manually joinable together (with the hinge pin), as desired.

15                   3.     The conventional mechanical hinge is by its nature neither monostable nor bistable -- that is, it favors positioning of the hinge plates in neither the closed nor open orientations, as opposed to any of the intermediate orientations. While in many applications it is preferred that the hinge remain with the hinge plates in whatever orientation they were last left by the user, in  
20 other applications it is preferred that the hinge be biased to assume an open orientation, a closed orientation or either orientation. (The “open” orientation may be with the hinge plates either transverse to one another (that is, at 90° to one another) or parallel and substantially non-overlapping (that is, at 180° to one another)). It is typically necessary for the conventional mechanical hinge to  
25 employ a biasing element (or gravity) acting on at least one of the hinge plates if the hinge is to be monostable, (i.e., biased to a preferred orientation) or bistable (i.e., biased to one of two preferred orientations as opposed to an intermediate orientation therebetween).

                  4.     The conventional physical hinge has a single constant pivot  
30 axis aligned with the physical hinge pin. For particular applications it may be

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preferred to have a hinge with a floating hinge axis – that is, a hinge axis which moves from one position to another as the plates move between the open and closed orientations.

Accordingly, it is an object of the present invention to provide a  
5 magnetic or virtual hinge characterized by a virtual hinge axis.

Another object is to provide such a hinge wherein in one preferred embodiment there is no hinge pin either to increase the physical dimensions of the hinge or occupy space intermediate the hinge plates.

A further object is to provide such a hinge wherein in one  
10 preferred embodiment the hinge plates are readily manually separable to deconstruct the hinge and readily manually joinable to reconstitute the hinge.

It is also an object of the present invention to provide such a hinge wherein in one preferred embodiment the hinge is monostable or bistable.

It is another object to provide such a hinge wherein in one  
15 preferred embodiment the hinge axis relocates as the hinge plates move between the closed and open orientations.

It is a further object to provide various devices which may profitably incorporate such a hinge.

#### SUMMARY OF THE INVENTION

20 It has now been found that the above and related objects of the present invention are obtained in a virtual or magnetic hinge having a virtual hinge axis. The hinge is devoid of a physical hinge pin. The hinge comprises a first hinge plate of non-magnetic material, at least one first magnet disposed in the first plate adjacent the hinge axis for movement therewith, a second hinge  
25 plate of non-magnetic material, and at least one second magnet disposed in the second plate adjacent the hinge axis for movement therewith. The first and second plates are movable about the hinge axis between a closed orientation and an open orientation. In the closed orientation the first and second plates are generally parallel and at least partially overlapping, and the first and second  
30 magnets are generally parallel, overlapping and in the same magnetic

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orientation. In the open orientation the first and second plates are generally parallel and at least partially non-overlapping, and the first and second magnets are generally parallel, non-overlapping and in the opposite magnetic orientations, the first and second magnets also being coplanar and aligned along  
5 a common axis.

In one preferred embodiment, the first plate and the at least one first magnet are readily manually separable from the second plate and the at least one second magnet to deconstruct the hinge. The first plate and the at least one first magnet are preferably more readily manually separable from the  
10 second plate and the at least one second magnet to deconstruct the hinge when the plates are in the open orientation than when the plates are in the closed orientation. The first plate and the at least one first magnet are readily manually joinable with the second plate and the at least one second magnet to reconstitute the hinge.

15 In another preferred embodiment, in the open orientation, the first and second plates are disposed in a common plane, and the first and second magnets are closely adjacent in the common plane. In the closed orientation, the first and second plates are disposed in two parallel planes, and the first and second magnets are closely adjacent and superposed in the two  
20 parallel planes.

In a further preferred embodiment, the first and second plates are pivotable about the hinge axis between the closed and open orientations. The hinge axis is either stationary during pivoting of the plates or relocated during pivoting of the plates. The hinge is devoid of a physical hinge pin.

25 In yet another preferred embodiment, the hinge is bistable and characterized by a lack of stability when the plates are intermediate the closed and open orientations. In this case, the first and second magnets present a right angle adjacent the hinge axis. Alternatively, the hinge is not bistable. In this case, the first and second magnets present a smooth curve adjacent the hinge  
30 axis.

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At least one of the first and second plates preferably incorporates means to preclude relative sliding movement thereof parallel or transverse to the hinge axis. The hinge axis may extend tangentially and/or intermediate to the peripheries of the first and second plates in both the closed and open orientations.

Optionally, the first plate has disposed therein at least a spaced apart pair of first magnets and the second plate has disposed therein at least a spaced apart pair of second magnets. In the closed orientation, each of the first magnets is generally parallel to and overlapping a respective one of the second magnets, and in the same magnetic orientation with respect thereto. In the open orientation, each of the first magnets is generally parallel to and non-overlapping a respective one of the second magnets and in aligned but opposite magnetic orientations with respect thereto.

Preferably, the first and second magnets are in essentially immediate physical contact in both the open and closed orientations.

As the hinge pin is virtual, the virtual hinge axis neither increases the physical dimensions of the hinge nor physically occupies space intermediate the plates.

The present invention further encompasses a cosmetic case incorporating the hinge, the first plate defining a base of the case and the second plate defining a cover of the case, the base and cover being movable between said closed and open orientations.

#### BRIEF DESCRIPTION OF THE DRAWING.

The above and related objections, features and advantages of the present invention will be more fully understood by reference to the following detailed description of the presently preferred, albeit illustrative, embodiments of the present invention when taken in conjunction with the accompanying drawing wherein:

FIG. 1 is an exploded isometric view of a two plate hinge according to the present invention in the closed orientation;

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FIG. 2 is an isometric assembly view thereof in the closed orientation;

FIG. 3 is a back elevational view thereof in the closed orientation;

FIG. 4 is a side elevational view thereof in the open orientation,  
5 with one plate being shown in an intermediate orientation in phantom line;

FIG. 5 is a top plan view thereof in the open orientation;

FIGS. 6 and 7 are sectional views thereof, taken along the lines of  
6-6 of FIG. 3 and 7-7 of FIG. 5;

FIG. 8 is a sectional view thereof taken along the line of 8-8 of  
10 FIG. 3 with one plate being illustrated in phantom line in an intermediate orientation;

FIG. 9 is an end elevational view of a three plate hinge according  
to the present invention in a closed orientation;

FIG. 10 is a rear elevational view thereof;

15 FIG. 11 is a fragmentary sectional view thereof with the first and  
second plates in an open end orientation and the second and third plates in a  
closed orientation, the first plate also being illustrated in phantom line in an  
intermediate orientation; and

FIG. 12 is a fragmentary sectional view thereof with the first and  
20 second plates in a closed orientation and the second and third plates in an open  
orientation, with the first and second plates also being illustrated in phantom  
line in an intermediate orientation.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Consonant with the description of a conventional mechanical  
25 hinge as consisting of two hinge plates and a hinge pin pivotally connecting the  
hinge plates, the following description employs the term "hinge plate" or  
"plate." However, it should be appreciated that, as in the conventional physical  
hinge, the "plate" need not be flat or thin (as might be suggested by use of the  
term "plate"), but may alternatively be possessed of an uneven non-flat surface  
30 and a thick or irregular non-thin configuration.



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Referring now to the drawing, and in particular to FIGS. 1-8 thereof, therein illustrated is a first embodiment of a hinge according to the present invention, generally designated by the reference numeral 10.

As best seen in the exploded view of FIG. 1, the hinge 10  
5 comprises a first hinge plate, generally designated 12, and a second hinge plate, generally designated 14, both plates being of non-magnetic material. At least one first magnet 16 is disposed in the first plate 12 for movement therewith, and at least one second magnet 18 is disposed in the second plate 14 for movement therewith. The first and second magnets 16, 18 are disposed in the  
10 first and second plates, 12, 14, respectively, adjacent the hinge axis 20.

As illustrated in FIG. 1, the magnets 16, 18 have a vertically oriented magnetic orientation with the bottom major face being north (N) and the top major face being south (S). Typically, the magnets 16, 18 are thin flat rectangles or squares (whether with right angle corners or corner radii). The  
15 magnets 16, 18 may be glued to the first and second plates 12, 14, respectively, for movement therewith. Where the plates 12, 14 are formed of a thermoplastic material, heat sealing, ultrasonic bonding or similar techniques may be used for securing together the plates and the magnets. While the first and second magnets 16, 18 are typically in immediate physical contact (either face-to-face  
20 in the closed orientation or end-to-end in the open orientation), the mechanics of heat welding or ultrasonic bonding may result in a slight separation of the first and second magnets (typically by no more than 0.5 mm), but the first and second magnets remain in essentially immediate physical contact.

The first and second plates 12, 14 are movable about the hinge  
25 axis 20 between the closed orientation illustrated in FIGS. 2-3 and the open orientation illustrated in FIGS. 4-5. In the closed orientation of FIGS. 2-3, the first and second plates 12, 14 are generally parallel and at least partially overlapping, while the first and second magnets 16, 18 are generally parallel, overlapping and in the same magnetic orientation. In the open orientation of  
30 FIGS. 4-5, the first and second plates 12, 14 are generally parallel but at least

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partially non-overlapping, and the first and second magnets 16, 18 are generally parallel, but non-overlapping and in opposite magnetic orientations. In this open orientation, the first and second magnets 16, 18 are coplanar and aligned along a common axis.

5           The first plate 12 and the first magnet 16 are readily manually separable from the second plate 14 and the second magnet 18 to deconstruct the hinge 10. Thus, each plate 12, 14 may be removed from the vicinity of the other plate 14, 12 for separate use. The first plate 12 and the first magnet 16 are preferably more readily manually separable from the second plate 14 and  
10   the second magnet 18 to deconstruct the hinge when the plates 12, 14 are in the open orientation (than when the plates 12, 14 are in the closed orientation) and when the magnets 16, 18 are in an end-to-end orientation (than when the magnets 16, 18 are in face-to-face orientation). It will be appreciated, however, that this is not necessarily always the case. The first plate 12 and the first  
15   magnet 16 are readily manually joinable with the second plate 14 and the second magnet 18 to reconstitute or reconstruct the hinge 10 in either the closed or open orientation.

          In a preferred configuration of the magnets 16, 18, each major face thereof is of greater area than an end thereof (the major faces being the top  
20   and bottom faces, as illustrated in the closed orientation of FIG. 1). Thus the magnetic attraction is stronger when the magnets are in the closed face-to-face orientation than when the magnets are in the open end-to-end orientation. Preferably, the magnets 16, 18 are relatively thin squares with the major faces thereof aligned with the plates 12, 14 in which they are disposed. In the closed  
25   orientation of FIGS. 2-3 wherein the first and second plates 12, 14 are generally disposed in two parallel planes, preferably the major faces of first and second magnets 16, 18 are closely adjacent (and optimally in contact) and superposed. (Where the first and second magnets 16, 18 are of common length and common width (that is, of the same planar dimensions), the term "superposed" is used to  
30   mean in complete vertical alignment and not just partially overlapping). In the

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open orientation of FIGS. 4-5 wherein the first and second plates 12, 14 are generally disposed in a common plane, the first and second magnets 16, 18 are closely adjacent (and optimally in contact) along a common axis. It will be appreciated that, because the facing end surfaces of the first and second magnets 16, 18 in the open orientation are of lesser area than the facing major faces of the first and second magnets 16, 18 in the closed orientation, magnets 16, 18, and hence the plates 12, 14, are more readily manually separable (that is, less force is required for separation) in the open orientation than in the closed orientation.

10 Referring now to FIG. 8 in particular, assuming that the first and second magnets 16, 18 are rectangular in outline, in essentially face-to-face contact in the closed orientation, and in essentially end-to-end contact in the open orientation, the first and second plates 12, 14 are pivotable about a virtual hinge axis 20 between the closed and open orientations, respectively. In the open orientation the virtual hinge axis 20 extends tangentially to and intermediate the tops of the contiguous rear edges of the first and second plates 12, 14.

Hinge embodiment 10 may be bistable if each of the first and second magnets 16, 18 is of appreciable thickness and has a major face and an end extending at a right angle to one another adjacent hinge axis 20, as illustrated. In the bistable hinge, each of the first and second magnets is preferably non-cylindrical, and optimally a rectangular parallelepiped. Alternatively, the hinge may be other than bistable if each of the first and second magnets extends in a smooth curve from the major face to the end adjacent the hinge axis. For example, if the first and second magnets are circular in cross-section (that is, if the magnets are cylindrical) and extend parallel and tangential to a common hinge axis, the hinge is non-stable. On the other hand, if the ends of the magnets facing the hinge axis in the open orientation are rounded, but the magnets still have major faces opposing one

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another in the closed orientation, the hinge may be monostable -- that is, stable in the closed orientation only.

At least one of the first and second plates 12, 14 preferably incorporates means to preclude relative sliding movement of the plates 12, 14 parallel or transverse to the hinge axis 20 while the plates are in the closed orientation. As illustrated in FIGS. 1 and 5-7, in the closed orientation the bottom face of upper plate 12 has a downwardly extending peripheral projection 13 on the front and sides thereof and a part of the rear, and the top face of lower plate 14 has a downwardly opening peripheral groove or recess 15 on the front and sides thereof and a part of the rear. The projection 13 snugly mates with groove or recess 15 when the plates 12, 14 are in the closed orientation. This construction precludes not only relative sliding movement of the plates 12, 14 along or parallel to the hinge axis 20 when the plates are in the closed configuration, but also relative sliding movement of the plates 12, 14 transverse to the hinge axis 20.

In a preferred embodiment, the first plate 12 has disposed therein at least a spaced apart pair of first magnets 16, 16 adjacent to hinge axis 20 and the second plate 14 has disposed therein at least a spaced apart pair of second magnets 18, 18 adjacent to hinge axis 20. In the closed orientation, each of the first magnets 16, 16 is generally parallel to and overlapping a respective one of the second magnets 18, 18 and is in the same magnetic orientation with respect thereto. In the open orientation, each of the first magnets 16, 16 is generally parallel to and non-overlapping a respective one of the second magnets 18, 18 and in an opposite magnetic orientation with respect thereto. The provision of a plurality of first magnets 16 and second magnets 18 assists in definition of the virtual hinge axis 20 and thereby decreases the possibility of an unintended manual separation of the first and second plates 12, 14 during movement of the plates between the closed and open orientations.

Because the hinge pin is only virtual and not physical, the virtual hinge axis 20 does not increase the physical dimensions of the hinge 10 and the

virtual hinge axis 20 does not physically occupy space intermediate the hinge plates 12, 14. As the hinge axis 20 neither increases the physical dimensions of the hinge nor physically occupies space intermediate the hinge plates, the hinge can be extremely compact and allow maximum utilization of the space

5 intermediate the plates.

The magnets 16, 18 are preferably of small size but significant strength and may be formed of alnico, neodymium (a rare-earth metal) or like materials of high magnetic flux.

The hinge 10 of the present invention may be incorporated in a  
10 wide variety of different consumer and industrial products. By way of example, the hinge 10 is illustrated in FIGS. 1 and 2 in the context of a modular hinge compact or cosmetic case, generally designated 30. One of the plates (here, upper plate 12) defines a cover 32 of the case 30, and the other of the plates (here, lower plate 14) defines a base 34 of the case 30, the base 34 and cover  
15 32 being movable between closed and open orientations, as illustrated.

Optionally, as best illustrated in FIG. 5, the cover 32 includes a mirror 36, and the base 34 includes a cosmetic 38 (such as a powder, base, lipstick, eyeshadow or the like) which may be applied while looking into the mirror 36 or "checked" thereafter by looking into the mirror 36. Conveniently, the cosmetic 38 is  
20 disposed in a removable pan 40 (see FIGS. 6 and 8) which is insertable into and removable from the base 34 with the cosmetic 38 therein as a unit. The pan 40 may be of metallic material, and the second magnets of the second plate 14 or base 34 may act to releasably maintain the pan 40 (and hence the cosmetic 38 therein) in place. The mirror 36 is preferably slightly recessed in the cover 32  
25 so that it is not in contact with the cosmetic 38 in base 34. An appropriate recess or groove 42 may be provided in the base 34 for storage of a cosmetic applicator (such as a powder brush, eyeliner pencil, lipstick brush or the like). Where there are a pair of second magnets 18, 18 the applicator recess or groove 42 is conveniently disposed intermediate the second magnets 18, 18.

Because the cover 32 and base 34 of the compact 30 (i.e., first plate 12 and second plate 14 of hinge 10) may be manually readily separated from one another, the separated mirror-containing cover 32 may conveniently be leaned against a separate support ease of viewing while the user holds the base 34 and applies the cosmetic 38 therefrom. Of course, base 34 or the pan 40 may be divided to hold more than one cosmetic 38, and, indeed, the base 34 may be configured to hold a plurality of smaller pans rather than a single large pan 40. Where the pans 40 are releasably maintained in base 34, they are preferably easily replaceable to allow interchanging of different colored eye shadow or face powder combinations. Downwardly extending central rim or projection 44 of cover 32 and the upwardly opening central recess or groove 46 of base 34 cooperatively function - - along with projection 13 and recess 15 - - to seal the cosmetic 38 within the compact 30 while the cover 32 and base 34 are in the closed orientation, thereby preventing escape of eye shadow, face powder, or the like from the closed compact 30. Rim 44 and groove 46 also cooperate with projection 13 and recess 15, respectively, to preclude relative sliding movement forward and rearward of the base 32 and cover 34.

A preferred compact case 30 according to the present invention may have dimensions as small as 2" x 1¼" x 3/8" with each of the two first magnets 16, 16 and two second magnets 18, 18 being as small as ¼" x 1/8" x 1/8". No internal volume of the compact being wasted on a physical hinge pin. The cover and base are readily manually separable and readily manually reconstituted. The compact is bistable and possesses a relocatable hinge axis.

Referring now to FIGS. 9-13, in the event that another compartment is desired for the compact 30, a third plate 50, as illustrated essentially identical to the base 34 (with or without a pan 40), may be added to the bottom of the compact 30, thereby increasing its thickness by ½ as best seen in FIGS. 9 and 10. The third plate 50 may be pivoted relative to the base 34 and separated from and/or reconstituted therewith.

Referring now to FIG. 11 in particular, second and third plates 14, 50 may be pivoted as a unit relative to first plate 12, or vice versa, about a stationary virtual hinge axis 20 between the open and closed orientations. However, referring now to FIG. 12 in particular, when the third plate 50 is pivoted relative to the second plate 14 (or the first and second plates 12, 14, as a unit), or vice versa, the initial virtual hinge axis 20 relocates itself to a second virtual hinge axis 20'. Initial virtual hinge axis 20 is intermediate and tangential to second and third plates 14, 50 in the open orientation, with the upper major faces on the second and third plates horizontally aligned in a common plane; relocated virtual hinge axis 20' is still intermediate to the second and third plates 14, 50 in the open orientation, but now it is adjacent one major face (here, the upper major face of plate 50) but not the other major plate face (here, the upper major face of plate 14) since the two upper major faces are no longer horizontally aligned in a common plane, but rather somewhat vertically offset. (Instead, the magnets 18, 52 of second and third plates 14, 50 are horizontally aligned in a common plane.)

FIG. 12 illustrates movement of the first and second plates 12, 14 as a unit relative to third plate 50, or vice versa, so as to expose the contents of the third plate 50 for use.

Referring now to FIG. 13 in particular, the third plate 50 is tri-stable--that is, it is stable not only in the closed orientation and open orientations relative to the base 34, but additionally in the single intermediate orientation of FIG. 13 wherein it is generally transverse (at a right angle) to the base 34. In this third stable orientation, the initial virtual hinge axis 20 between the base 34 and the third plate 50 relocates as the latter moves from the closed orientation to the stable intermediate orientation. This is because the base 34 is thicker than the second magnet 18 so that the second magnet 18 of base 34 and the magnet 52 of the third plate 50 are not in contact and are appreciably spaced apart when the third plate 50 is in a closed orientation with the base 34.

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As one pivots the front of plate 50 from the closed orientation relative to a plate 14 held stationary, at some point the pivoting of the plate 50 about the hinge axis 20 will transition sharply from a smooth pivoting to a slight jerk as the hinge axis relocates relative to the plate 14 and the plate 50 jerks  
5 into the vertically offset stable intermediate orientation of FIG. 13. This vertical relocation of the hinge axis is, of course, possible only because the hinge is devoid of a physical hinge pin.

Should still further compartments be desired for the compact 30, additional components generally similar to third plate 50 or base 34 may be  
10 added as desired.

To summarize, the current invention provides a magnetic or virtual hinge characterized by a virtual hinge axis. The hinge has no hinge pin either to increase the physical dimensions of the hinge or occupy space intermediate the hinge plates. The hinge plates are readily manually separable  
15 to deconstruct the hinge and readily manually joinable to reconstitute the hinge. The hinge may be nonstable, monostable or bistable. The hinge axis may relocate as the hinge plates move between the closed and open orientations. Various devices may profitably incorporated such a hinge.

Now that the preferred embodiments of the present invention  
20 have been shown and described in detail, various modifications and improvements thereon will become readily apparent to those skilled in the art. Accordingly, the spirit and scope of the present invention is to be construed broadly and limited only by the appended claims, and not by the foregoing specification.



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I CLAIM:

1. A magnetic hinge defining a hinge axis, comprising:
  - a. a first hinge plate of non-magnetic material;
  - b. at least one first magnet disposed in said first plate
  - 5 adjacent the hinge axis for movement therewith;
  - c. a second hinge plate of non-magnetic material; and
  - d. at least one second magnet disposed in said second plate adjacent the hinge axis for movement therewith;
  - said first and second plates being movable about the
  - 10 hinge axis between:
    - i. a closed orientation wherein said first and second plates are generally parallel and at least partially overlapping, and said first and second magnets are generally parallel, overlapping and in the same
    - 15 magnetic orientation, and
    - ii. an open orientation wherein said first and second plates are generally parallel and at least partially non-overlapping, and said first and second magnets are generally parallel, non-overlapping and in
    - 20 opposite magnetic orientations, said first and second magnets being coplanar and aligned along a common axis.
2. The hinge of Claim 1 wherein said first plate and said at least one first magnet are readily manually separable from said second plate and
- 25 said at least one second magnet to deconstruct said hinge.
3. The hinge of Claim 1 wherein said first plate and said at least one first magnet are more readily manually separable from said second plate and said at least one second magnet to deconstruct said hinge when said plates are in the open orientation than when said plates are in the closed
- 30 orientation.

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4. The hinge of Claim 2 wherein said first plate and said at least one first magnet are readily manually joinable with said second plate and said at least one second magnet to reconstitute said hinge.

5. The hinge of Claim 1 characterized by a lack of stability  
5 when said plates are intermediate said closed and open orientations.

6. The hinge of Claim 1 wherein, in said open orientation, said first and second plates are disposed in a common plane, and said first and second magnets are closely adjacent in said common plane.

7. The hinge of Claim 1 wherein, in said closed orientation,  
10 said first and second plates are disposed in two parallel planes, and said first and second magnets are closely adjacent and superposed in said two parallel planes.

8. A cosmetic case incorporating the hinge of Claim 1, one of said plates defining a base of said case, and the other of said plates defining a  
15 cover of said case, said base and cover being movable between said closed and open orientations.

9. The hinge of Claim 1 wherein said first and second plates are pivotable about the hinge axis between said closed and open orientations.

10. The hinge of Claim 9 wherein the hinge axis is stationary  
20 during pivoting of said plates.

11. The hinge of Claim 9 wherein the hinge axis is relocated during pivoting of said plates.

12. The hinge of Claim 1 wherein the hinge is devoid of a physical hinge pin.

25 13. The hinge of Claim 1 wherein the hinge is bistable.

14. The hinge of Claim 13 wherein the first and second magnets present a right angle adjacent the hinge axis.

15. The hinge of Claim 1 wherein the hinge is not bistable.

16. The hinge of Claim 15 wherein the first and second  
30 magnets present a smooth curve adjacent the hinge axis.

17. The hinge of Claim 15 wherein the first and second magnets are elongated.
18. The hinge of Claim 1 wherein at least one of said first and second plates incorporate means to preclude relative sliding movement thereof parallel or transverse to the hinge axis.
19. The hinge of Claim 1 wherein said first and second magnets are non-circular.
20. The hinge of Claim 1 wherein said first and second magnets are elongated.
21. The hinge of Claim 1 wherein said first and second magnets are rectangular.
22. The hinge of Claim 1 wherein the hinge axis extends tangentially to the peripheries of said first and second plates in both said closed and open orientations.
23. The hinge of Claim 1 wherein the hinge axis extends intermediate the peripheries of said first and second plates in both said closed and open orientations.
24. The hinge of Claim 1 wherein, in both said open and closed orientations, said first and second magnets are in essentially immediate physical contact.
25. The hinge of Claim 1 wherein the hinge pin is virtual.
26. The hinge of Claim 1 wherein the hinge axis does not increase the physical dimensions of said hinge.
27. The hinge of Claim 1 wherein the hinge axis does not physically occupy space intermediate said plates.
28. The hinge of Claim 1 wherein the hinge axis neither increases the physical dimensions of said hinge nor physically occupies space intermediate said plates.
29. The hinge of Claim 1 wherein said first plate has disposed therein at least a spaced apart pair of first magnets, and said second plate has

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disposed therein at least a spaced apart pair of second magnets; each of said first magnets being generally parallel to and overlapping a respective one of said second magnets, and in the same magnetic orientation with respect thereto in said closed orientation, and each of said first magnets being generally parallel to  
5 and non-overlapping a respective one of said second magnets and in aligned but opposite magnetic orientations with respect thereto in said open orientation.

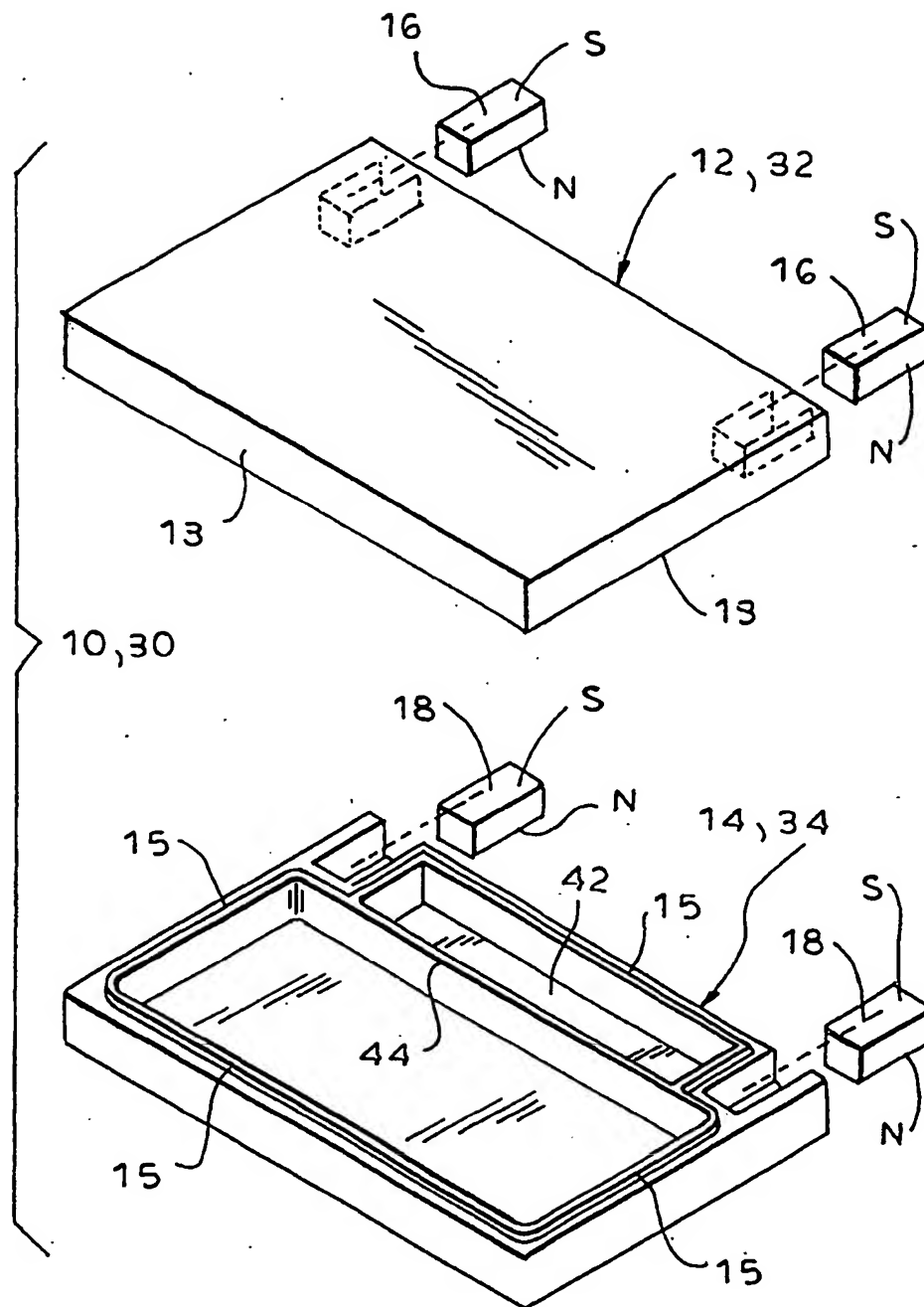


FIG. 1

FIG. 2

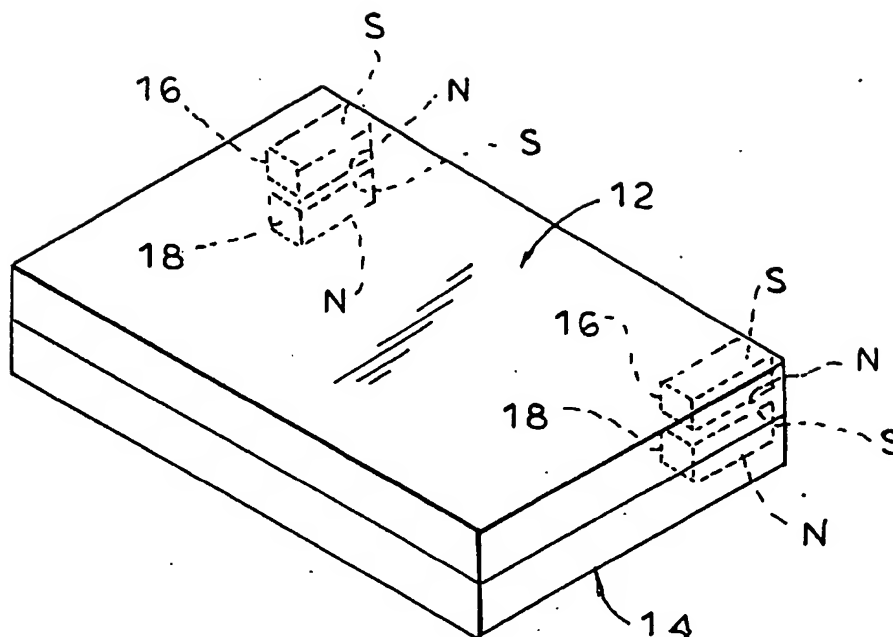
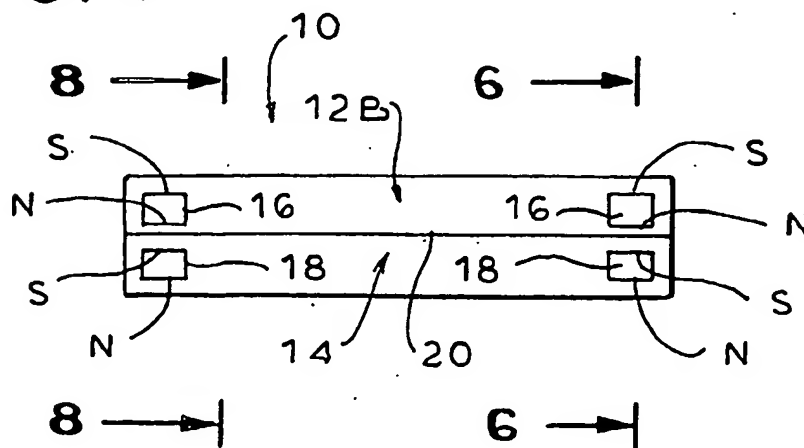


FIG. 3



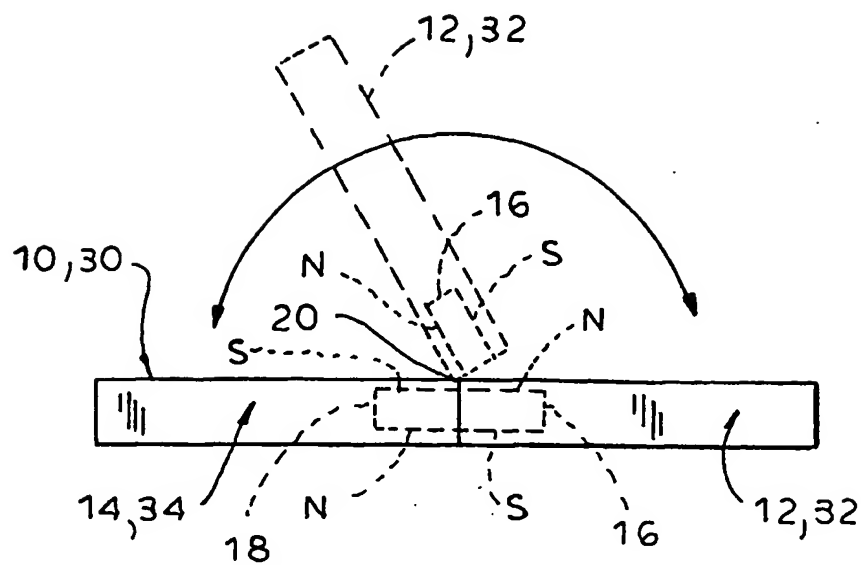


FIG. 4

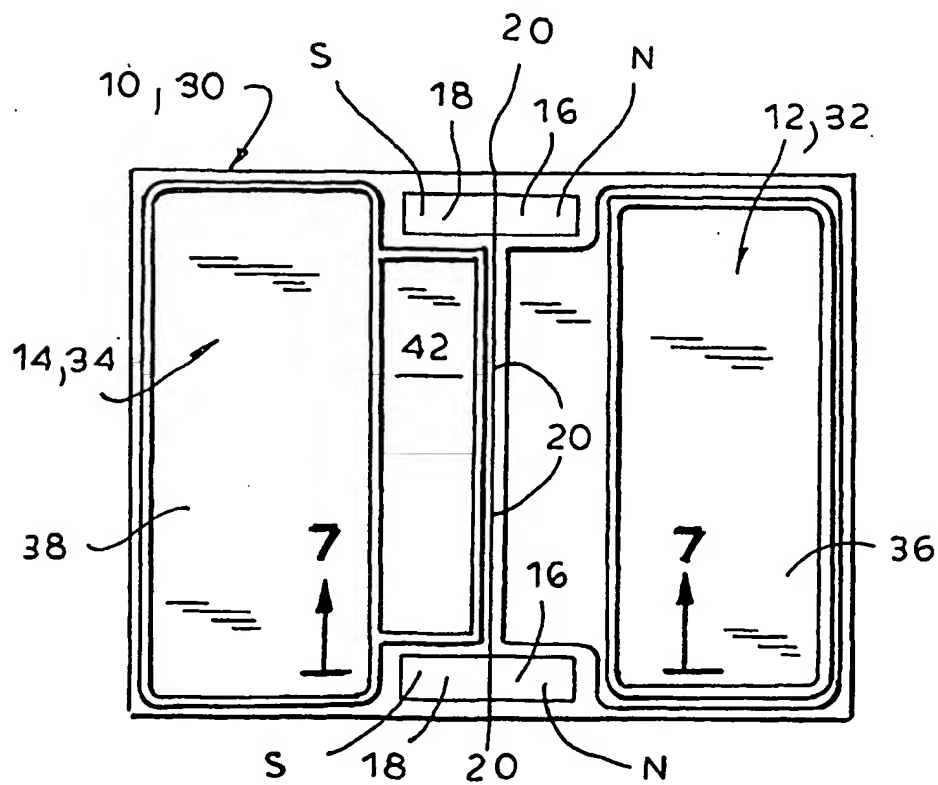


FIG. 5

FIG. 6

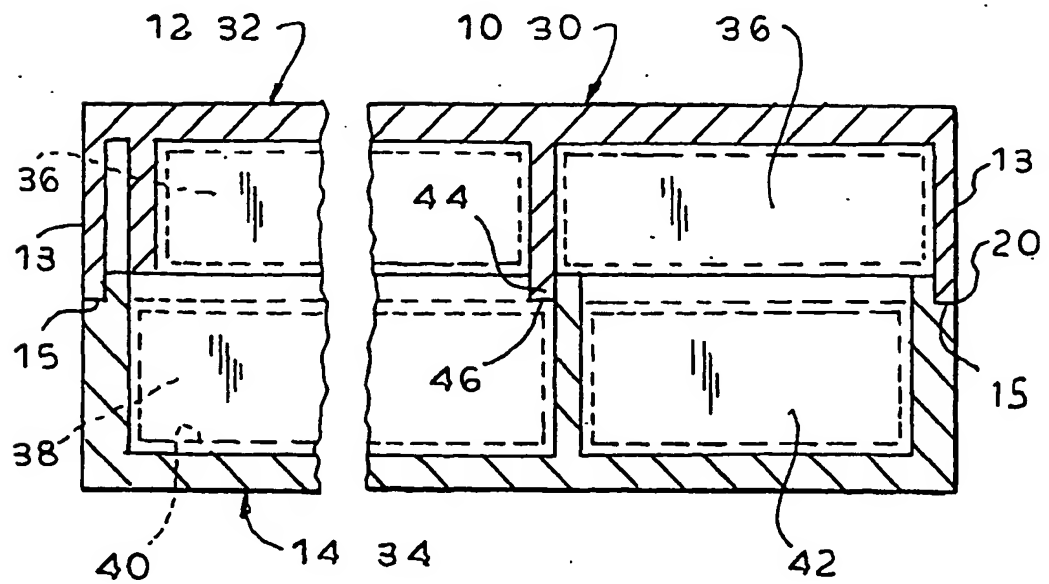
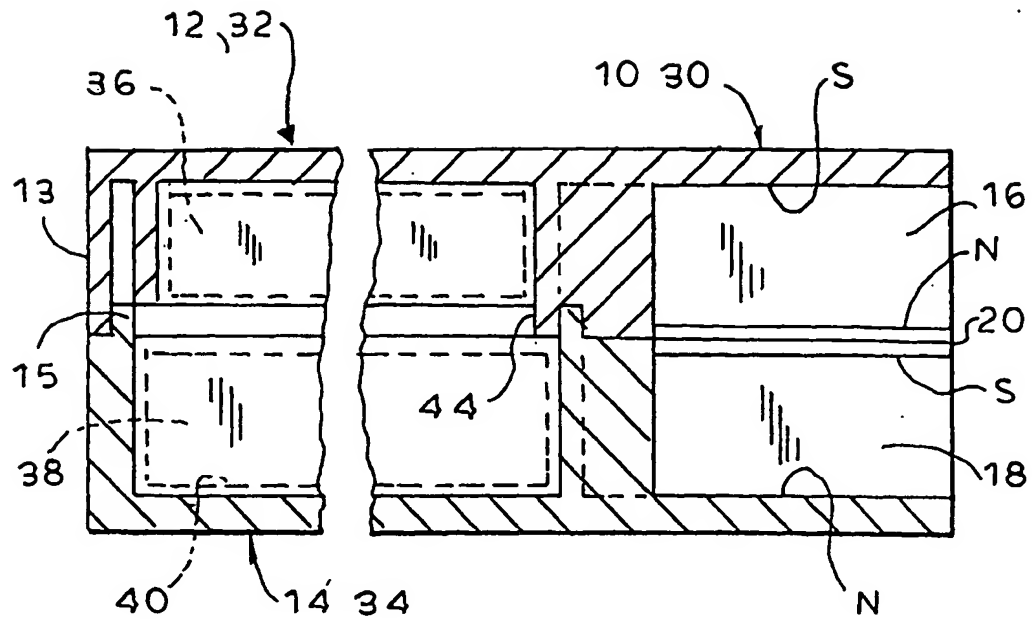


FIG. 8



FIG. 7

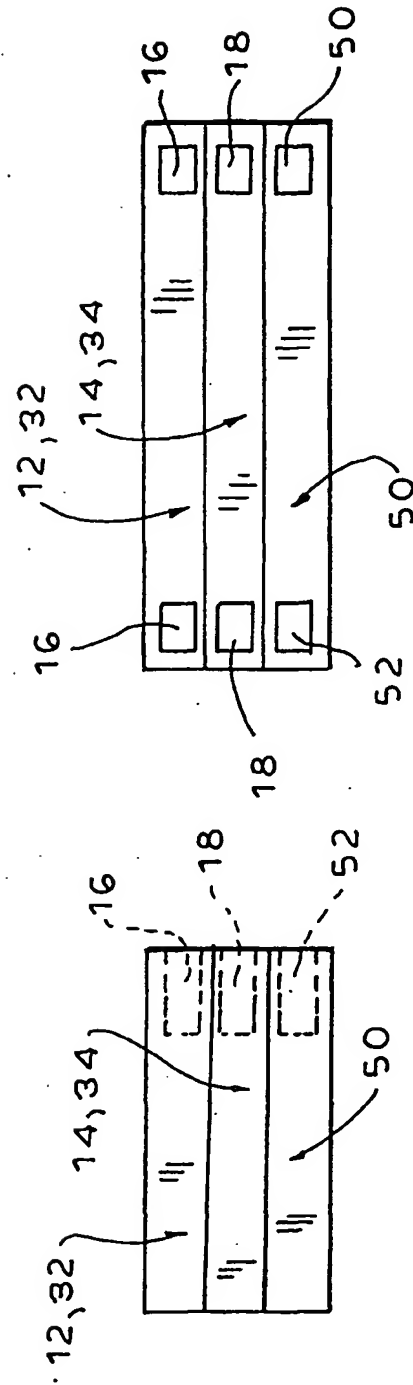
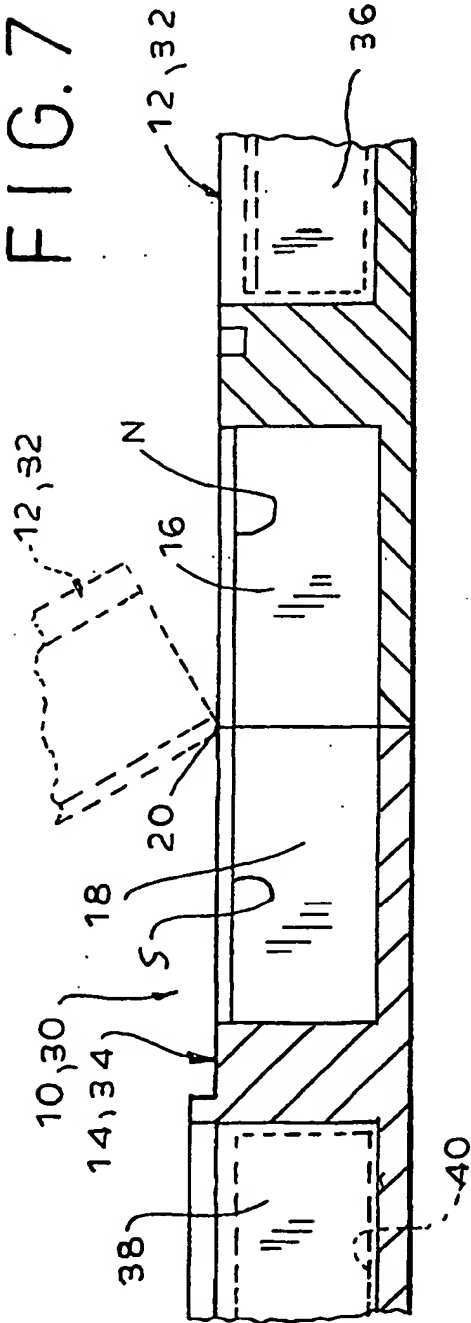


FIG. 10

FIG. 9

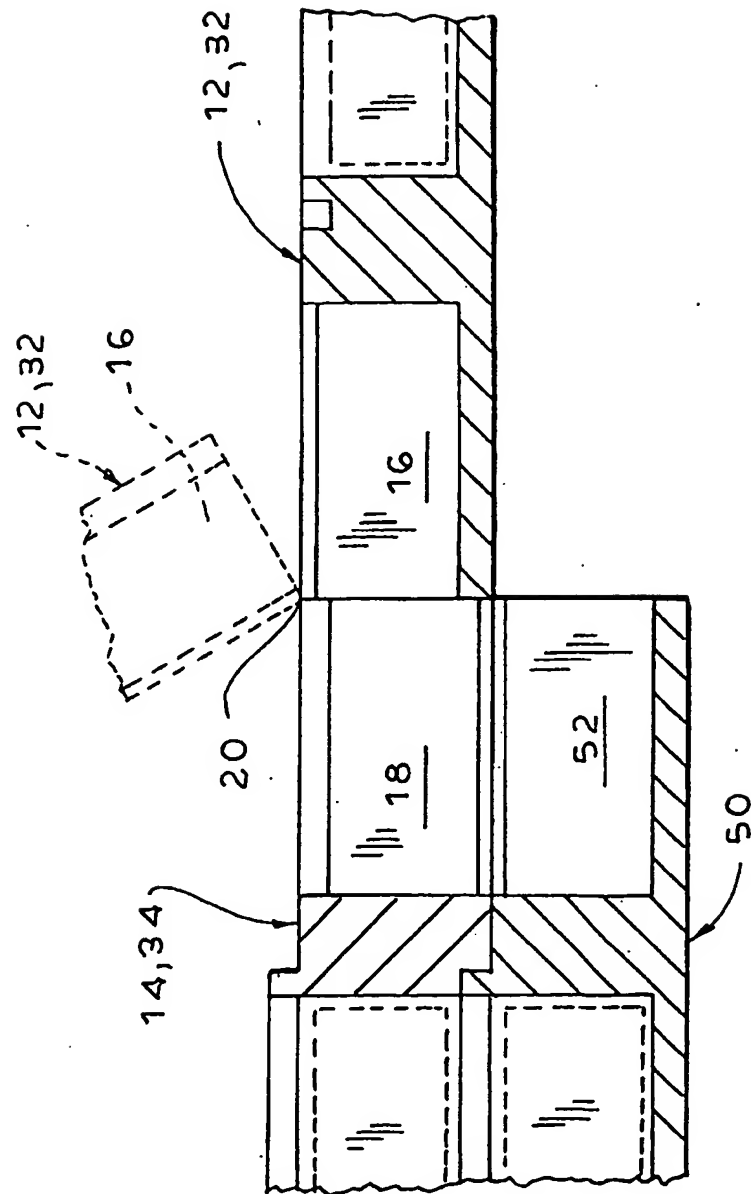


FIG. 11

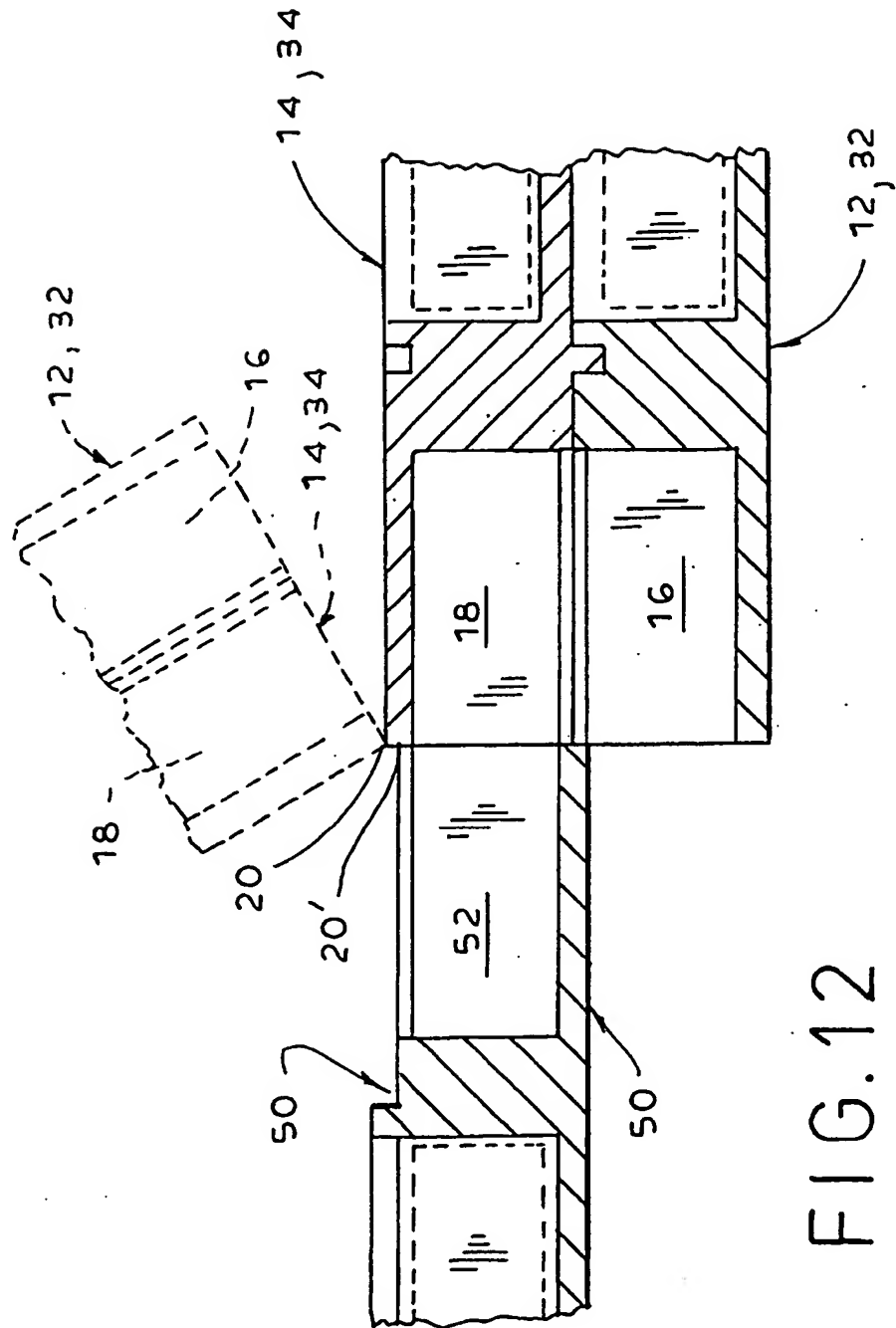
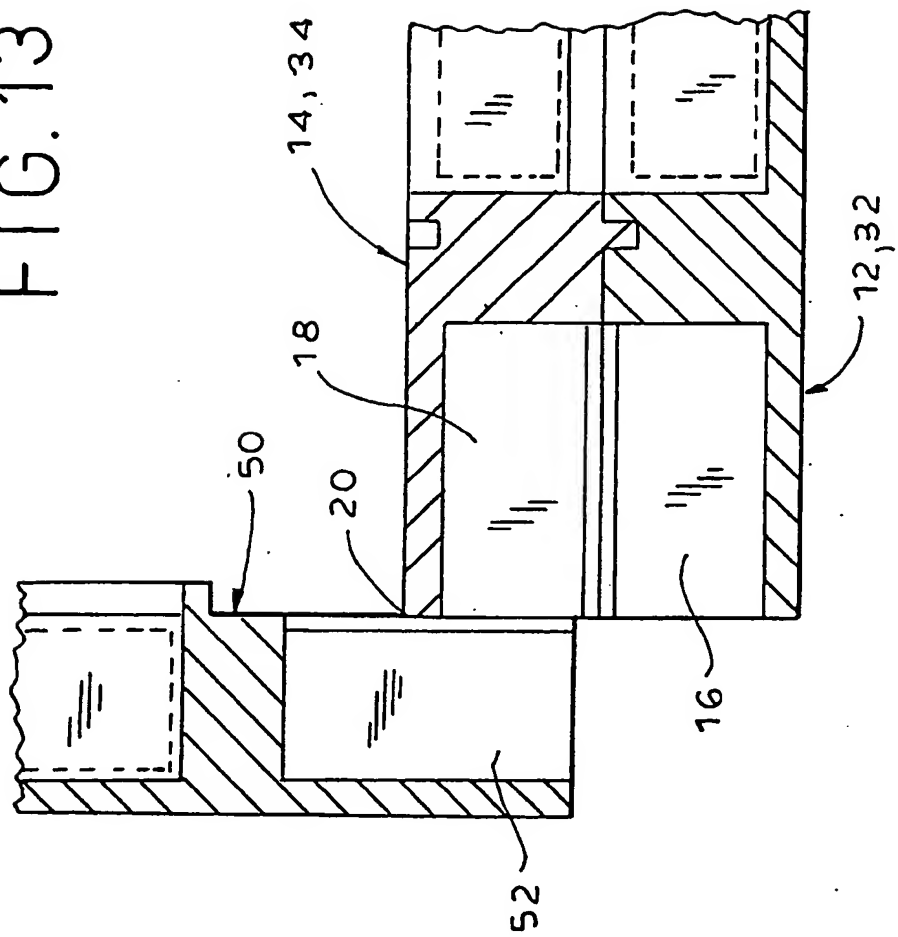


FIG. 12

FIG. 13



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US02/13093**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) :B65D 51/00

US CL :220/230

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 220/230,810,845,4.21,4.22,4.24; 16/320; 206/818,823; 132/294,295

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X - Y	US 3,152,716 A (FELDHAHN) 13 OCTOBER 1964, see entire document.	1-4,6-14, 18-21, 23-28 ----- 1-15, 17-22, 24- 28
Y	US 5,135,012 A (KAMEN et al) 04 AUGUST 1992, see fig. 8.	1-15, 17-22, 24-28

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

28 JUNE 2002

Date of mailing of the international search report

15 JUL 2002

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